Ontario

fish and wildlife Review

Vol. 14, No. 4, 1975

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Review

VOL. 14, NO. 4 WINTER, 1975

We proudly offer two earth-moving reports of great interest to outdoorsmen. Our biologists have met and worked with earth-moving engineers and found them to be co-operative. It's the theme of this Review.

Since Bob Beecher layed it on the line, he has become fish and wildlife supervisor at Lindsay, following Percy Swanson who retired (to write his memoirs, he said) in September.

Engineers again . . . John Mathers reports the effects of highway construction and operation on Galt Creek.

Foresters too . . . . Tim Timmermann returns with pointed comments on the effects of lumbering on fish and wildlife habitats, and a nice photo of a spruce grouse for our back cover.

Vanishing . . . . Lake trout and authors. A fond farewell to Russ Whitfield who retired in October.

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The goal of the Ministry of Natural Resources is to provide opportunities for outdoor recreation and resource development for the continuous social and economic benefit of the people of Ontario, and to administer, protect and conserve public lands and waters.

Ontario

Ministry of Natural Resources

Hon. Leo Bernier
Minister

Dr. J. K. Reynolds
Deputy Minister

EDITORIAL

REMAKING THE EARTH

So much of man's impact upon the environment is of a geological nature. Man is shaping the landscape as effectively as geological forces did in the past. Of course man's efforts are not cataclysmic but they certainly have resulted in significant alterations.

Dams impede the flow of water and cause silt accumulation. Rivers are channelized to move the water quickly through flood-prone areas. Large areas of land are water-proofed with roads, parking lots, sidewalks and buildings. Great cities affect the surrounding atmosphere. Open mines pock the earth's crust.

The building of a long, winding highway may also be considered a geological event. The narrow lane of rocks and asphalt alters water flow and prohibits plant growth. Thus, man is more than an observer of geological events or formations. He actually creates them.

During the passage of time, waterways have found their courses and water tables have found their levels. The soil has been enriched with organic elements, and the carpet of vegetation has held the topsoil together. But over much of our land these natural balances have been disrupted by man's artificial formations.

The land, and the water within it, is the foundation of all life. If, for example, soil were unable to absorb and retain water we would not have plant life. And yet with many of our structures and practices we prevent absorption from taking place. No wonder water tables are dropping.

It is only recently that we have come to understand the complexity of our eco-systems and the fragility of the intricate web of faunal and floral elements. This new knowledge must be incorporated into future plans in the remaking of the earth. Nature is indiscriminate in altering the face of the earth but man, if he wishes, can plan so that his alterations will harmonize with the natural landscape.

Man has his roots in the natural environment. He may want highways and cities but he needs the forests, fields and waters. He can have both — urbanization and nature — but it will require much courageous planning.

LETTERS IN REVIEW

Readers of 'Review' are invited to set forth their views in these columns

GIANT CANADAS

In Volume 14, No. 2, it is stated that giant Canada geese nested in southwestern Ontario generations ago.

There is no evidence that Canada geese of any kind nested here in pre-settlement days. The Jesuit Fathers observed during the 17th century that Canada geese were present in spring and fall and many descended on the corn fields of the Indians. Some were caught, and the bones of these birds have been found at recent excavations of former Indian villages. Some geese were kept by Huron Indians but only for short periods of time.

There are no specimens of breeding birds in the Royal Ontario Museum nor any reports that birds, other than those kept by farmers or other residents, bred in southern Ontario, although apparently geese did breed in Michigan.

The only evidence that giant Canada geese were ever here comprises one bone found at the Cherry Hill site by Dr. H. Savage, ROM, and that bone accompanied a bone from a large domestic goose.

The recent breeding success of geese in southern Ontario is undoubtedly due to habitat changes which have occurred in the past 150 years. Local breeding stock, observed since 1850, have probably resulted from crippled or released stock.

The term, re-introduction, with reference to Canada geese, is a mis-nomer. It would be tenuous indeed to state that the birds ever bred naturally here at all.

R. M. Alison, Waterfowl Biologist
Wildlife Branch

MONTREAL RIVER

Thank you very much for sending us Volume 14, No 2. We are very interested in 'Review' and believe it has improved very much.

Most of the time from fall to spring, we stay in our log cabin on Loon Lake near Cobalt and fish in the Montreal River. In the past year, whitefish have increased very much. Fishing from the shore or near it from the end of October to mid-November always brought good catches. In winter, fishing through the ice with a clean Williams Wabbler in 20 to 30 feet of water was good. I thought this might interest you.

(Mrs.) Frances Cardinal
R.R. 2, Breslau, Ontario.

CONSTANCE LAKE — MOST PRODUCTIVE LAKE

In a recent issue of Ontario Fish and Wildlife Review, Pembroke District proclaimed Mud Lake as the Bullhead Capital of the Ottawa Valley. Rather than dispute this claim, Ottawa District would like to propose Contance Lake as the Most Productive Lake in the Ottawa Valley. Thirteen miles west of Ottawa, Constance Lake has an area of 325 acres and a mean depth of six feet. A creel census conducted between May 11 and September 2, 1974, showed that 3,788 anglers caught 5,890 pike, 3,380 bullheads, 2,388 perch and 2,238 of other species (sunfish etc.). A creel census of ice fishing, presently under way, suggests that ice fishing accounts for at least as many fish as the open water season. That means Constance Lake provides anglers with almost 80 fish of all species per acre of water. Reports dating back to 1952 indicate that Constance Lake has been heavily used by anglers and maintained high angler success over the years. This small lake is also used for cottaging, swimming and a float plane base, and it provides excellent waterfowl hunting in the fall! — *G. M. Tupling*

LITTER

Two students were hired this summer to clean up some of the lakes in the District. It took them six weeks to bag and haul 272 bags of garbage from the various camp and shore-lunch sites on Pipestone Lake. This amounts to almost five tons of garbage on a lake that is not accessible by road. A most disheartening fact is that, since the clean-up, garbage has again been deposited by users of the lake. We ask the co-operation of all people who use our outdoors in helping to keep our lakes and rivers clean. We urge you to "Take It With You."

— *D. J. D'Agostini, Manager, Fort Frances District*

The shoreline area of lakes and streams is valuable to wildlife. Logging practices should be required to retain some shelter and escape cover.

THE FOREST INDUSTRY AND FISH & WILDLIFE

Report and Photos by H. R. Timmermann
Regional Moose Biologist, North Central Region

THE forest is in a constant state of change. At the beginning of this century, wildfires swept through northwestern Ontario consuming hundreds of thousands of acres of timber. In the late 1940s and early 1950s, spruce budworm infestations destroyed large tracts of coniferous forest. The natural process of fire and large-scale insect infestation drastically changed the forest environment and animal populations. Some changes were beneficial; others were detrimental.

During the past two decades, the harvesting of trees has had the biggest impact on northern ecosystems. One forest operation can destroy more habitat, kill more fish and wildlife, wreck more nests, move more animals, and influence more cover over a longer time than a game manager with today's funds can create, plant, stock, raise or import in a decade (Giles, 1962).

Until recently, most wildlife benefits achieved as a result of logging, and there are many, have been incidental. Animals have adapted, moved or perished when their environment was radically altered. (Pengelly, 1972).

Let us first establish some basic ecological principles. Forests are three-dimensional environments having more height or depth than other terrestrial environments. In ecological terms a forest has an abundance of different habitats. Forests have more ecological niches, producing a variety of animal species, than most other environments. Many forest-dwelling animals, such as moose and deer, use vegetation growing near the ground. Woodpeckers are adapted to using tree trunks as their niche. Some specialized creatures dwell in the tops of trees, very high above the ground.

Wildlife and fish have adapted themselves to the diverse habitats of the forest and its waterways (Appendix A, B and C). "Diversity of animals in a community is not solely the consequence of plant diversity. Differences in climate and microclimate, competition between species with similar ecological requirements, predators, and para-

sites also cause diversity." (Webb, 1973).

The forest community is dynamic, changing from season to season, year to year, and century to century. Natural forces such as wind, fire, disease and insects cause trees to die and allow regeneration. The natural succession of the forest affects animal populations. As the forest develops from a pioneer community to a climax forest, each stage has its characteristic fauna.

Tolerance to enironmental disturbances varies widely. Some animals can stand very little change while others thrive after severe habitat disturbance.

Logging operations can be beneficial to some species and detrimental to others (Resler, 1972). Activities that increase the number of deer or moose may destroy habitat for other species — the nesting site for a bald eagle, the forage area for a great-horned owl, the travel route of a pine marten, or the spawning bed of a brook trout.

However, a basic truth about the boreal forest as well as most others is that "a virgin forest and scant wildlife populations are usually synonymous." (Swift, 1952). Dense stands of mature trees generally provide lean rations for most wildlife species because they have little grassy or shrubby understory.

Let us look at some of the wildlife and fish found in the forests and waterways of northwestern Ontario and document their response to logging and forest management practices.

Ungulates such as moose and deer are mammals of the early shrubby stages of forest succession. Where fires and plant diseases are controlled, logging is the main factor allowing forest regeneration. Usually the shorter the cutting cycle, and the more extensively the forest canopy is opened, the more beneficial logging is to these animals. However, areas of mature forest are also needed for protection in winter.

MOOSE

Logging has generally benfited moose by providing large areas of new growth. "When mature trees are cut, young trees often sprout in profusion providing abundant twigs for moose to eat." (Cumming, 1972). Moose populations generally increase in recently logged areas. Increases in moose populations have been correlated with such activities in Minnesota (Peek, 1971). Later, habitat quality decreases as forest succession proceeds and the general stages of the forest grow beyond the reach of moose (Krefting, 1973).

Before modern, fully mechanized logging, cutting operations tended to be widely dispersed across the landscape. In addition individual cut-overs tended to be small, and operations per unit area took place over a long period of time.

A mixture of stands of all ages is very important to forest ruminants such as moose (Pimlott, 1962). Adequate coniferous cover was frequently left in or near logged areas. This pattern provided moose with an abundance of food and relief from deep snow. Dense softwood and mixed-wood stands are required during the mid-winter when deep snow restricts movement (Telfer, 1970).

With mechanization, a common practice is the cutting of huge blocks of forest. Large-scale clear-cutting followed by scarification, produces increased food for moose but often destroys winter shelter. This pattern of clear-cutting sharply contrasts with the pattern of many wildfires which often leave a patchwork of unburned timber surrounded by lightly burned and heavily burned areas.

Snow depths and wind velocities are greater in open areas than in the forest. Clear-cuts often have four times the snow depth and 30 times the wind velocity of adjacent, mature, uncut stands (Pengelly, 1972).

Modified cutting systems, using strips or blocks, are beneficial for moose, especially in winter-range areas. Large clear-cuts are not as beneficial as they could be if forest edges were modified to produce openings more natural in shape. The actual acreage of cut openings is less important than the distance between forest edges (Hough and Stansbury, 1973). Forest cover should be provided at inlets and outlets to lakes and ponds where marshes make good moose feeding habitat.

DEER

Deer moved into northwestern Ontario from neighbouring Minnesota in the 1900s as a result of logging activities and land clearing (Cumming and Walden, 1970).

Logging which opens the forest canopy results in more food for deer. In southern Ontario, Matiece (1969) demonstrated that range improvement cuttings around deer yards produced a five-fold increase in browse after two growing seasons. Deer foods grown in full sunlight after logging are usually more nutritious than those grown in dense shade.

Mature stands of cedar, spruce, balsam and hemlock (and jack pine in the northwest) provide shelter for deer in winter. The major

Modified logging practices maximize the vital forest edges and provide a variety of age and species compositions for the benefit of wildlife.

Two yearling moose take advantage of abundant growth that follows logging.

problem is to develop a forest management plan which schedules cutting operations in the stands so that good range conditions are maintained in the area at all times. It is important to limit the amount of coniferous cover cut in deer yards. In northwestern Ontario, where deer do not yard, it is important to maintain some areas of conifers for shelter.

GROUSE

Good habitat for ruffed grouse includes an abundance of young trees, shrubs and plants, located in both upland and lowland topography with some forest openings.

Over large areas, commercial logging operations are important in producing grouse range. "Basic forest management practices, including thinning, improvement cutting and harvest, usually benefit grouse." (Dawson, 1972). But there is an optimum forest age. If cutting removes a stand, a new one forms and is better for a time. If this is done in adjacent tracts, forest exploitation is a positive force.

But large clear-cuts often eliminate habitat. Gullion (1970) found in northern Minnesota that "cutting all of the mature aspen from a forested tract of 40 acres or larger is almost a certain means of eliminating overwintering and breeding ruffed grouse from forested areas."

It takes two or three years after an aspen stand has been logged before it begins to provide habitat for broods. "At about 10 to 12 years the stand has grown and thinned sufficiently to provide the quality of habitat required year-round by adult grouse." Once the aspen stand grows beyond the age of 20 to 25 years it is no longer best-quality, year-round habitat for this species (Gullion, 1969).

Grouse have a small home range, and any change of forest cover (either by logging or fire), that covers an area much larger than 10 acres, reduces the breeding density for a number of years. Uneven-aged, selectively-cut forests and small clear-cuts with plenty of edge generally provide good habitat.

Both the spruce and northern sharp-tailed grouse prefer coniferous forest habitat. Modern clear-cut logging almost eliminates these species until a new coniferous forest is re-established.

WOODLAND CARIBOU

Woodland caribou often use mature boreal forest habitats (Cringan, 1957). An important winter food consists of tree and ground lichens. Caribou will paw through more than three feet of snow to obtain the latter.

Most woodland caribou in Ontario (of which there are about 13,000 remaining (Simkin,1965)) are found in the northern, unlogged boreal forest and the Hudson Bay lowlands. For many years the disappearance or woodland caribou to the south has been attributed to many environmental changes such as forest fires, settlement and logging. More recent evidence suggests that hunting mortality and predation also play an important role.

A few scattered local herds survive in the commercial forest zone along the north shore of Lake Superior, on Lake Nipigon islands and in the Irregular Lake area northwest of Kenora. If these herds are to survive, their ranges must be identified and managed for caribou as well as wood fibre.

BIRDS AND SMALL MAMMALS

In general, birds and small mammals are not evenly distributed across their ranges and each species prefers certain types of surroundings. Distribution patterns within the range are often intricate, and population densities vary according to the quality of habitat.

Horned larks seek open areas and avoid woodlands while brown creepers inhabit woodlands and shun treeless areas. The pileated woodpecker requires a mixture of mature forest with plenty of chicots. The pine marten, on the other hand, prefers the solitude of the deep coniferous forest. Eagles, ospreys and hawks often nest in isolated tall trees, usually near water.

Some species of ducks, such as the wood duck, hooded merganser and common goldeneye, nest in natural tree cavities or large woodpecker holes. Large logging operations, involving clear-cutting, can destroy these habitats. However, loggers are usually required to leave a reserve forest area around lakes and rivers, and this benefits some of these species.

AERIAL SPRAYING

The use of chemicals to control insects and undesirable plants has become a major environmental issue. Herbicides, fungicides and insecticides may affect wildlife which ingest these chemicals with their food. Broad-spectrum chemicals such as DDT have in the past affected wildlife and fish populations in many subtle ways. Carson (1962) lists countless cases of major fish kills caused by

Clear-cut logging destroys wildlife cover and winter shelter.

Log drives have reduced or eliminated fish production in some waters.

forest insect spraying from New Brunswick and Maine in the east to Montana and Yellowstone Park in the west.

Fish-eating birds, such as bald eagles, ospreys and peregrine falcons, have accumulated high concentrations of chlorinated hydrocarbons in fatty tissues. Reproduction often has been eliminated and these birds are now endangered species (Godfrey, 1970) Heavy kills of young Atlantic salmon occurred in New Brunswick as a result of DDT spraying (Kerswill and Edwards, 1967).

Herbicide spraying has been used to retard undesirable vegetation and release desirable coniferous seedlings. Chemicals such as 2,4-D and 2,4, 5-T were chiefly employed in the past. Herbicides retard shrub growth for a year or two. In most cases more sprouting results, providing more food than was originally present. Deer and moose benefit from such an operation while the habitat of other mammals and birds may be destroyed.

FIRE

Prescribed or controlled burning has long been used as a forest management tool and can also improve and maintain the habitat of many species. Deer, moose, ruffed-grouse and many small mammal and bird populations respond very quickly to the habitat which develops after fire. Too many people think of fire as the great destroyer of forests and animals. They should know that, properly used, fire can create food and shelter for future wildlife generations.

LOGGING ROADS

The logging industry depends on roads to harvest and extract timber. Thousands of miles of primary, secondary and tertiary access roads ribbon our commercial forest landscape. Hunters, fishermen and campers swarm over these roads as though they lead to the promised land. Many types of all-terrain vehicles now penetrate beyond roads to the very hinterland. The harvest of game species coincides closely with forest access routes. There is no doubt the logging industry has made much forest land accessible to hunters and other recreationists. This is normally considered a benefit and generally viewed as desirable.

However, such access has, in some cases, imposed stress on some species. The lake trout, a slow growing, late maturing and rather unproductive fish, has been particularly affected by angling pressure brought about by greater access in recent years. Some local moose herds have also been shown to be over-harvested.

WATER QUALITY

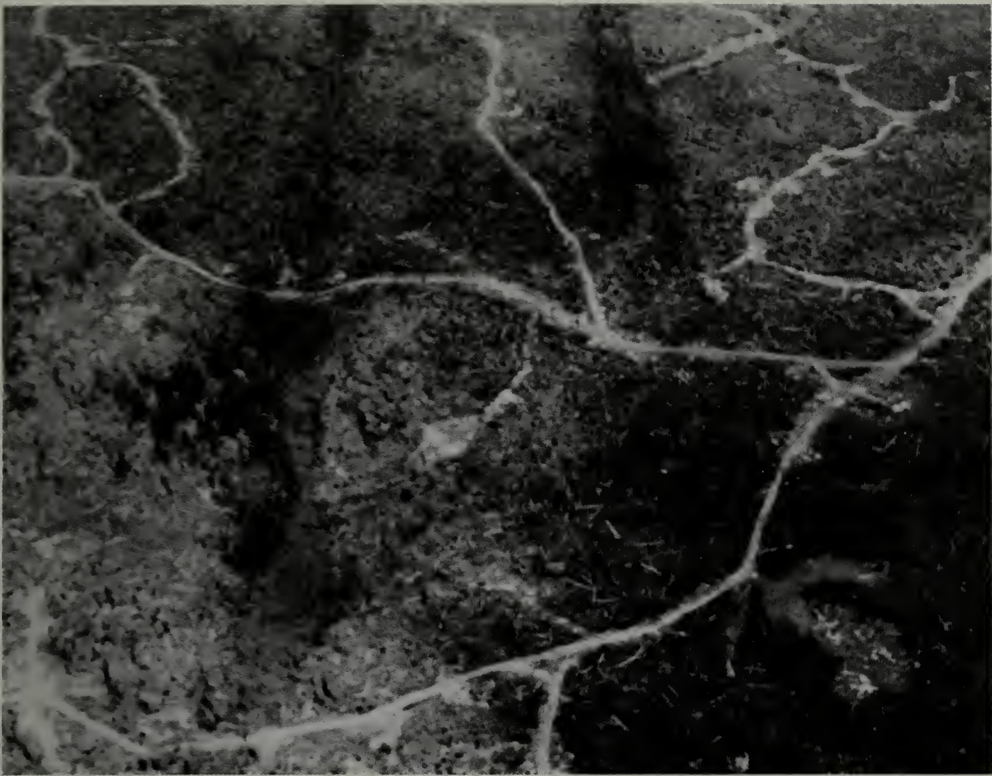
Stream flow, or total water yield, is greatest immediately after logging and is rapidly reduced in subsequent years as vegetation becomes established. "Excessive run-off from logging roads, yarding areas, landings and skid trails appears to be the chief cause of changes in the stream regimen" (Webb, 1973). Such changes may affect fish in several ways. During high flooding periods "shifting of bottom materials and scouring of fish embryo in stream beds may seriously reduce natality, and survival may be reduced if fish organisms are swept downstream by flood waters." (Webb, 1973). Conversely, during low-water periods, fish populations and food organisms may diminish because of inadequate stream flow.

Logging roads frequently cross or run beside water courses. Temporary bridges and culverts, which are hastily installed, often are a serious cause of stream deterioration. Poorly located and poorly constructed logging roads can cause abnormally high turbidity in nearby streams (Lieberman and Hoover, 1948; Reinhart and Phillips, 1959). Turbid water, resulting from soil materials washed directly into streams, affects the survival of fish species and reduces the light penetration which in turn influences the abundance of fish organisms. As soil materials settle out, they often smother fish food organisms and cover gravel deposits used for spawning.

Clear-cutting near streams results in significantly higher maximum stream temperatures in the summer and lower minimum temperatures in winter (Eschner and Larmoyeux, 1963). High water temperatures have repeatedly been given as the most important factor limiting the distribution and survival of trout.

Logs are sometimes stored in water to prevent deterioration or they are transported down rivers and across lakes. Disengaged bark from logs settles to the bottom, covering spawning beds and changing the entire bottom environment. This makes it impossible for many fish and fish food organisms to survive (Ryder and Johnson, 1972).

One investigator found that the "history of log driving in many spawning streams showed fish spawning ground destruction frequently resulted from the gouging, hydraulic erosion and so-called river 'improvements', that is, the straightening of the river associated with log drives." After only one year of log driving, it was found that a



Logging roads give access to anglers, hunters and other recreationists.

Ruffed grouse populations respond to logging — for good or bad.

40 per cent reduction occured in the salmon spawning run of the Stellako River in British Columbia.

Tsang and Gibson (1972), studying the effects of driving over two million cords of pulpwood down the Sturgeon River into Lake Nipigon for 27 years, found layers of accumulated bark six to 18 inches thick on the gravel bottom. Islands in the river were covered with bark and pulpwood debris up to six feet deep. They estimated about 15 per cent of the river banks had been damaged by log dumps, landings and erosion.

Sturgeon have been vulnerable to habitat destruction caused by river driving and the discharge of woody allochthonous materials during the heyday of the pioneer lumbering industry (Harkness and Dymond, 1961).

Although log driving is nearly phased out, it may take centuries for accumulated materials to decompose and disappear. Meanwhile in many of these waters fish production has been reduced or eliminated.

Dams constructed for log driving on Lake Superior streams are thought to have prevented the expansion of sea lamprey into up-stream watersheds. They have also limited the spawning potential of anadromous fish such as the rainbow trout.

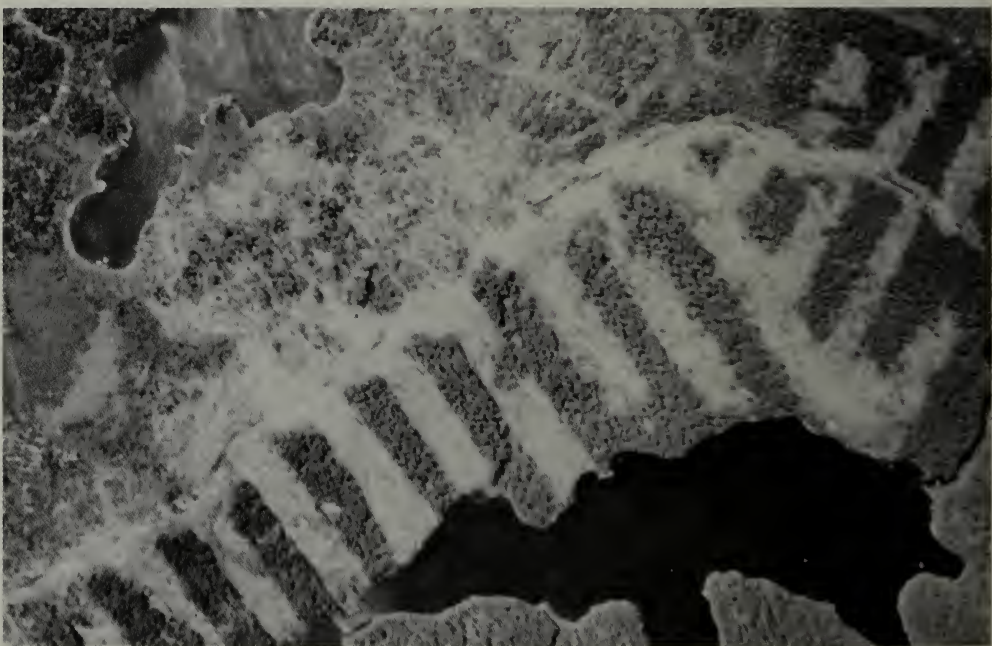
ED. NOTE — A copy of the literature cited by the author will be mailed to readers on request.

Pulp mills, which are always located near water, have been a major source of industrial water pollution. "Kraft mill wastes have eliminated complete fisheries or contributed at least in part to their demise" (Ryder and Johnson, 1973).

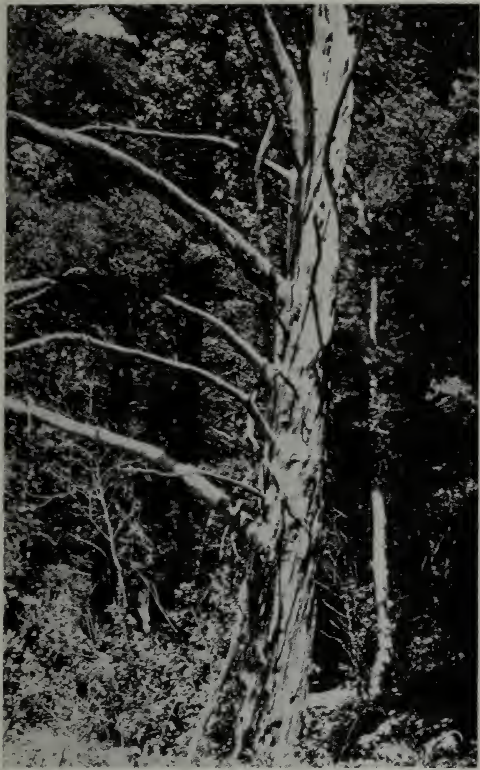
Recently high levels of mercury in fish have been analysed from water downstream or adjacent to some pulp and paper mills in northern Ontario. Levels higher than half a part per million of mercury render these fish unmarketable, and some tourist resorts and commercial fisheries have had to close down.

In summary, logging and wood processing have had a profound effect on fish and wildlife in northern Ontario. Some of these effects have been beneficial but most, it seems, have been detrimental.

In future, with the staggering prospects of doubling and tripling the extent of present annual logging operations, it will be even more difficult to co-ordinate logging with fish and wildlife management. Economic gain is still paramount in most decision making processes. Logging concerns must learn to recognize benefits other than their own. Modified cutting systems should be the rule rather than the exception. Vegetation diversity of both age and species should be our objective in managing forests and wildlife. Good forest management is good wildlife management.



Strip cutting provides new "edges" for wildlife.



Large dead trees provide nest and den sites for birds and mammals.

Wildfire may create ideal wildlife habitat — a variety of new growth.

APPENDIX A: WILDLIFE USING FOREST OPENINGS

Wildlife Using Clearings, Edges and Trails (Hamilton and Ruttle, 1973)

Species	Uses	Habitat Provided
Moose, White-Tailed Deer	Food	Twigs of shrubs and trees in winter.
Black Bear	Food	Berries in summer and fall.
Mice, Voles	Food	Grains, roots, grasses and insects.
	Cover	Tall grasses and dense bush.
Shrews, Moles	Food	Invertebrates (mainly).
Snowshoe Hare	Food	Seedlings and herbaceous plants.
	Cover	Dense edge growth — protection from predators.
Lynx, Bobcat, Weasel Wolf, Fox, Owl, Hawk	Food	Prey species.
Ruffed Grouse	Food	Foliage, twigs, catkins, buds, fleshy fruit, and insects for chicks in early summer.
	Dusting	Sandy, sunny areas for preening feathers.
	Snow Roosting	Protection against severe cold.
Songbirds (some species)	Food	Seeds and fruits.
	Nesting	Material for nests (twigs, grass, etc.) and nesting sites in shrubs and dense young tree growth.
Ravens, Crows	Food	Scavenging along roads, clearings and refuse areas.

APPENDIX B: WILDLIFE USING CLOSED-CANOPY FORESTS

Wildlife Using Mature and Over-Mature Stands (Hamilton and Ruttle, 1973)

Species	Uses	Habitat Provided
Moose White-Tailed Deer	Cover	Winter protection from wind chill, deep snow.
Woodland Caribou	Food	Ground and tree lichens in undisturbed mature coniferous stands, and deciduous twigs.
Black Bear	Food Denning	Insects in dead trees, standing and fallen. Base of old trees, windfalls, hollow logs, etc.
Squirrels, Chipmunks	Food	Nuts, berries, seeds, insects, invertebrates, and young birds & eggs in old trees.
Marten, Fisher	Food	Squirrels and chipmunks.
Snowshoe Hare	Denning	Spruce and cedar swamps (preferred).
Porcupine	Food Denning	Tree bark and herbaceous plants. Hollow logs and subterranean chambers.
Ruffed Grouse Spruce Grouse	Courtship Nesting Loafing	Old logs. Ground under closed canopy, sparse undergrowth. Roosting in tree branches.
Hawks, Owls	Nesting	All trees for nesting sites.
Woodpeckers	Food	Insects and grubs in decaying trees.
Herons, Ospreys	Nesting	Old or dead trees in isolated areas near water.
Ravens, Crows	Nesting	Mature trees.
Songbirds (some species)	Nesting	Mature trees.

APPENDIX C: FISHES USING FOREST-BORDERED WATERWAYS

Species	Uses	Habitat Provided
Lake Sturgeon	Reproduction Food	Shallow shoal waters of large rivers and lakes. Snails, clams, aquatic insects, crayfish, vegetation (bottom feeder).
Yellow Pickerel (Walleye)	Reproduction Food	Shallow water flowing over gravel, riffles, small falls. Variety — fishes, aquatic insect larvae, plankton.
Lake Whitefish	Reproduction Food	Rocky reefs, gravel or sandy shoals in lake, streams. Variety — plankton, molluscs, insects, small fishes.
Suckers	Reproduction Food	Stony or gravelly shoals. Bottom-living aquatic insects, snails, molluscs, plants.
Brook Trout	Reproduction Food	Shallow, silt-free gravel-bottom stream headwaters. Variety — insects, fishes.
Lake Trout	Reproduction Food	Rocky shoals or reefs, broken rubble, 4′ to 6′ water. Forage fishes, invertebrates, plankton.
Rainbow Trout	Reproduction Food	Clean, silt-free stream gravel. Other fishes and minnows.
Sea Lamprey	Reproduction Food, Larvae Food, Adult	Swift-flowing streams with gravel or stony bottom. Plankton in soft mud of streams. Blood and flesh of other fishes.

Wayne Helson, environmental watchdog on the line. Photos by Earl Baddaloo

LAYING IT ON THE LINE

by R. W. Beecher
Fish and Wildlife Supervisor, Lindsay District

BELIEVE it or not. Canadian energy problems are affecting 30 streams in Lindsay District. A pipeline is being constructed across Ontario to conduct petroleum from Sarnia to Montreal. As with any project of such magnitude, environmental impact becomes a major concern.

The operation of the Interprovincial Pipe Line Company is being closely watched along its entire length in Ontario by both the Ministry of Natural Resources and the Ministry of the Environment. The section from Markham to Trenton, which is probably the most environmentally sensitive area the pipeline will pass through, is already under construction.

Lindsay District personnel of the Ministry of Natural Resources are working closely with construction crews to ensure that all practical precautions possible are being taken to minimize detrimental impacts on the District's valuable streams, most of which support populations of brook, brown and rainbow trout.

Good trout streams are made up of clean pebble and rock bottoms along much of their lengths and include many riffles and pools. The riffles are turbulent areas which mix water with air, ensuring that the level of dissolved oxygen in the water remains high. Many riffle areas are spawning beds for trout. Eggs laid in stony nests called redds are provided with the necessary high concentrations of oxygen as the aerated water passes through.

After hatching and becoming mobile, the young trout rely on clean, rocky, stream bottoms for shelter and cover. As they grow larger, sheltered pools become an important component of their environment. The many small invertebrates which live in the spaces between gravel and pebbles in a stream bed are an important food source for the trout.

A major problem, which accompanies construction in a watershed where trout are indigenous, is the removal of the vegetation which stabilizes the stream banks during rainfall or snow-melt. Eroded soil particles

The scar of pipeline construction is temporary in most of its length, but the crossing of streams poses a permanent threat to trout production. Below, a sand-bag dyke traps sediment to return relatively clear water to the stream below.

Laying the 30-inch pipe below the flume that carries the water of Shelter Valley Creek across the pipeline ditch. In the closer view below, the flume discharges the water into a passageway that returns it to the creek downstream.

which find their way into a stream threaten trout populations. As the suspended sediment in turbid water settles out, it often covers riffles and fills in pools. No longer are the spaces between gravel available for spawning. No longer are they available for production of invertebrate food supplies for the trout. No longer are the pools available to provide shelter and cover for the fish.

The construction of the pipeline requires that a ditch be dug from 12 to 14 feet deep across each stream bed; that a 30-inch pipe, weighted with an 18-inch concrete collar, be laid about six feet beneath the stream bed; and that the ditched material be back-filled over the pipe. This operation destroys the immediate stream bed and stream banks but the process of siltation downstream poses an even more menacing threat to the well-being of the stream ecosystem.

Several precautions are taken to minimize the silt load travelling downstream. In small streams the ditch is dug across the stream bed while a sand-bag dyke conducts water into a culvert placed in the direction of the stream flow. The culvert carries the stream flow from above to below the excavation site where it returns the water to the stream bed.

The water then passes through a series of two or more sedimentation traps created by sand-bag dykes. These slow the stream flow and cause a high proportion of the suspended sediments to fall to the bottom. The silt deposited in these traps is removed as necessary and at the completion of the work. This technique is very effective in certain streams, but each situation poses its own peculiar problems.

Rehabilitative work, including bank stabilization and replacement of granular material in the streams for spawning and food production, is also being carried out.

In southern Ontario, the natural environment is subjected to many types of development. The pipeline is only one of many development projects, each of which can cause considerable destruction to stream ecosystems.

Quality ecosystems can be maintained in the face of developmental pressures only with the close co-operation of responsible agencies. The next time you pause by the clear waters of your favourite trout stream, consider that it is not luck but good management which will maintain such opportunities for generations to come.

Coating, wrapping and laying the big pipe.

Some people will build anywhere — and let the effluents run where they may.
— Photos by E. F. Anderson

OUR VANISHING LAKE TROUT

by R. E. Whitfield
Fisheries Biologist, Eastern Region

A COTTAGE on a deep, clear, cool lake has long been an Ontario dream. Early cottagers were drawn to such lakes because they could drink the water without boiling it, enjoy swimming and boating and catch all the trout required to satisfy the family needs. Recreational cottages grew rapidly until many of the lakes with the highest water quality were ringed with summer residences.

Unfortunately, these were the same lakes that supplied the high-quality environment required by lake trout. The record shows clearly that as development around the lakes increased, the lake trout populations decreased.

Many of these attractive lakes were found in granite rock basins, often with thin-soiled, sloping, rocky shorelines. They frequently carried natural populations of lake trout, lake whitefish, and cisco (herring). Since lakes of this type are generally low in productivity, good fishing lasted only while fishing pressure was light. For example, the crop of lake trout which can be harvested annually from these lakes is in the order of one-half to one pound per acre. Compare this with the three to four pounds per acre which can be harvested annually from the more shallow, warm-water, pike and yellow pickerel (walleye) lakes.

One of the detrimental effects of modern cottaging is the increased flow of nutrients from cottage to lake — in most instances because of insufficient soils to absorb and hold them.

The impact of early cottaging on water quality was much less for each cottage unit than it is now. In the beginning and for many decades, cottages usually lacked the conveniences of running water and indoor plumbing systems and they were often equipped with hand pumps. Outside, behind the cottage, the outhouse could be found, often hidden in a rocky niche well back from shore. Such facilities had little effect on water quality since the seepage, if any, seldom reached the lake.

The present linear cottage development along lake shores has been accompanied by the installation of automatic water-pressure systems, plumbing with flush toilets, showers, and even dishwashers. The advent of snowmobiles and increased interest in win-

Cottages with flush toilets, washers and dishwashers, and farmland with its chemical fertilizers. Everything runs down to the lake.

What lake can endure intensive development and still provide good fishing ?

Dredging a channel for larger boats with larger oil wastes.

ter outdoor recreation has led to the winterization of many cottages and their use the year round. The nutrients in cottage effluents thus enter the water in increased volume over a much longer time than formerly.

The problem with contemporary cottaging appears in many instances to rest with the rocky, sloping topography and thin soils along lake shores. In many cases the soils are incapable of absorbing and holding the volume of the effluents from modern indoor plumbing. The result is that many of the nutrients, especially the phosphorus contained in washing detergents, find their way into the lake.

High nutrient loads, rich in phosphorus, are responsible for profuse algal growth in lakes and rivers. Dead, rotting algae, as well as decaying rooted aquatic vegetation, create a high oxygen demand while they are being broken down by bacterial action. This frequently results in seriously low levels of oxygen in lake basins.

During the summer months, lake trout, lake whitefish and cisco inhabit the deep basins of lakes because of their preference and need for cool water in which to survive. If the oxygen is depleted in the lake basin during this critical summer period, then there is nowhere for these deep-water fishes to go — except to extinction.

Direct physical damage to lake environments has occured through cottaging and other lakeshore developments. Even the early cottagers unwittingly exerted stresses upon the most vital and productive part of the lake — the shore and its parallel band of shallow water,called the littoral zone, where most of the food items which support fish life are produced. They attacked the shore with axe and scythe, brushing away all or most of the low cover along the lake frontage. If aquatic vegetation grew in the littoral zone, it was removed to improve conditions for swimming, boating and the construction of docks for power boats.

Disturbances such as these, although they may appear to some persons to be of minor importance, have collectively contributed to the deterioration of the natural environment of the lake.

In agricultural areas, lake environments may be impaired by farm fertilizers and silts reaching the lake by direct run-off or through tributary streams. The fertilizers add to the over-enrichment of the water and the silts destroy natural spawning grounds, adversely affecting the natural reproduction of lake trout. Fortunately, in Ontario, farming is carried on at only a minimum level on the rocky precambrian shield where most of the lake trout lakes are located.

Other stresses imposed on lake trout populations over the past half century include the manipulations of the water levels in the reservoir lakes used for power production. During the critical spawning and egg incubation periods, the water levels have been somewhat less than advantageous in spite of the many joint efforts which have been made to correct this situation.

Highly piscivorous fishes, such as the yellow pickerel (walleye), were introduced into fragile lake-trout environments before early managers fully understood the competitive effects of these species on the less prolific lake trout, and in some waters this meant the beginning of the end for the lake trout. This was because of the highly piscivorous nature of yellow pickerel, particularly, and their competition for food as well as space in the lake.

Of the estimated 250,000 lakes in Ontario, only about 2,000 support lake trout popultions, and only half of these are considered good producers.

In the Eastern Region of Ontario, an area of 10,771 square miles including water (except Lake Ontario) and agricultural and semi-agricultural land, a recent review of the history of lake trout shows that the lake trout once inhabited lakes with a total surface area of 90,224 acres.

To date lake trout have disappeared from 24,896 acres or 27.59 per cent of the waters that formerly supported natural populations. A further 11,959 acres, or 13.25 per cent of water containing lake trout both native and introduced, have suffered a severe decrease in population levels. These waters now contain merely remnant lake trout populations and rarely attract anglers who are looking exclusively for this species.

The remaining 53,369 acres, or 59.16 per cent, support fair to good populations of lake trout and attract anglers on a regular basis. In some of these waters, lake trout populations are supported by hatchery stocked fish. Were this hatchery support withdrawn there is little doubt that a considerable number of these lakes would revert to the "near remnant" category.

Many atttempts have been made to reintroduce hatchery reared lake trout in waters where natural populations once existed but had since disappeared. These attempts have met with failure for the greater part. It would appear that once the environmental requirements of lake trout are removed or rendered unfit for natural reproduction, there is little chance of reversing the environmental changes.

Some biologists believe that unless we arrest the present deterioration of water quality, and environmental conditions in general, especially in the lake trout lakes, it is entirely possible that lake trout may become nearly extinct in Ontario. It is imperative that we stop the downward trend in lake water quality.

INTROSPECT — ASSESSING WE WILL GO...!

A personal opinion not necessarily endorsed by the Ministry of Natural Resources

by E. F. Anderson, Supervisor, Plan Review Section, Land Use Co-Ordination Branch

After some heavy weather in the Legislature and some rather drastic surgery in committee, The Environmental Assessment Act of Ontario received third reading on July 14, 1975. Following its proclamation in 1976 all activities of the government will be subject to its influence.

Certain undertakings may be exempted initially, subject to regular review. Other undertakings, having a significant impact on the environment, will be designated by regulation. The regulations will include appropriate scheduling to indicate when each undertaking or group of undertakings will be subject to the conditions of the Act. This Act is administered by the Ministry of the Environment.

An undertaking is defined under Section

1(o) of the Act as follows:

"(i) An enterprise or activity or a proposal, plan or program in respect of an enterprise or activity by or on behalf of Her Majesty in right of Ontario, by a public body or public bodies or by a municipality or municipalities; or

"(ii) A major commercial or business enterprise or activity or proposal, plan or program in respect of a major commercial or business enterprise or activity of a person or person other than a person or persons referred to in subclause i that is designated by the regulations."

Under the Act "environment" means air, land and water; plant and animal life including man; the social, economic and cultural conditions that influence the life of man or a community; any building, structure, machine or other device or thing made by man; any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from the activities of man; or any part or combination of the foregoing and the inter-relationships between any two or more of them in or of Ontario.

The following comment was made recently to staff of the Ministry of the Environment. "My God! You have included everything but the kitchen sink." The reply was "Correction. We have included the kitchen sink."

The Act has many implications for the Ministry of Natural Resources and the Ministry is a proponent under the Act. Section 1(k) defines "proponent" as a person who "(i) carries out or proposes to carry out an undertaking; or (ii) is the owner or person having charge, management or control of an undertaking."

The Ministry's existing environmental policies may be confirmed and supported. If any policies are found wanting, they will be modified to meet evolving provincial environmental quality standards.

Certain program planning may be subject to public scrutiny. For example Section 7(2) states:

"Any person may inspect an environmental assessment of an undertaking and the review thereof in accordance with the terms of the notice referred to in Subsection (1) and may, within thirty days of the giving of the notice or within such longer period as may be stated in the notice,

"(a) make written submissions to the Minister of the Environment with respect to the undertaking, the environmental assessment and the review thereof; and

"(b) by written notice to the Minister, require a hearing by the Board with respect to the undertaking, the environmental assessment and the review thereof."

The Environmental Assessment Act, 1975, seeks to lessen the impact certain activities have on the environment. We must keep in mind that our obligations under this Act will require extra effort and expense, but the long-term benefits to the environment will be appreciated by all people.

The Ministry of Natural Resources is presently negotiating, with the staff of the Ministry of the Environment, its list of undertakings which will be subject to the Act. Fish and wildlife undertakings will be included in this list and many will therefore require an environmental assessment. Ministry staff are pleased to participate in this process.

Not all environmental assessments will be dealt with in the same way. Certain projects, because of their uniqueness or because of the sensitive nature of the ecosystem involved, will always require an "individual" environmental assessment. Projects in the fish and wildlife field requiring individual assessment include lake reclamation, new hatcheries and introduction of exotics.

Undertakings which are fairly common and are usually conducted on relatively stable ecosystems may be handled by a "class" environmental assessment. Fish and wildlife undertakings to be handled by a class environmental assessment include dikes, fishways, ponds, fish barriers, fish stocking, sediment control and cover management.

Where accepted planning processes exist for each undertaking or group of undertakings, the environmental concerns can be incorporated into the process. This ensures that the output of the planning process — the plan — reflects an adequate environmental conscience.

Initially "individual" and "class" environmental assessments will be needed to meet our obligation under the Act. We should progress as rapidly as possible, however, towards meeting these obligations through environmentally conscious planning.

The benefits to fish and wildlife should be many. In the past most project and program planners had little regard for the effects of their undertakings on fish and wildlife interests. The new Act should give all of us an improved environmental conscience.

Lake Simcoe has long been productive but it is ecologically sensitive.

JIGS, TEETERS AND TIP-UPS

Report and Photos by J. N. Lawence, Fisheries Management Officer
Lake Simcoe Fisheries Assessment Unit, Maple District

ICE, clear blue and thick, covers Lake Simcoe. It's January and the 280-square-mile lake is static white and austere as a desert. Polar-like winds howl across its surface and pressure cracks occasionally resound with thunderous booms. Many people find it a forbidding scene but winter fishermen find it exciting. For them it's time for warm clothes, ice augers, fishing huts, snowmobiles, jigs, teeters and tip-ups.

You don't need a hut — just an ice rod.

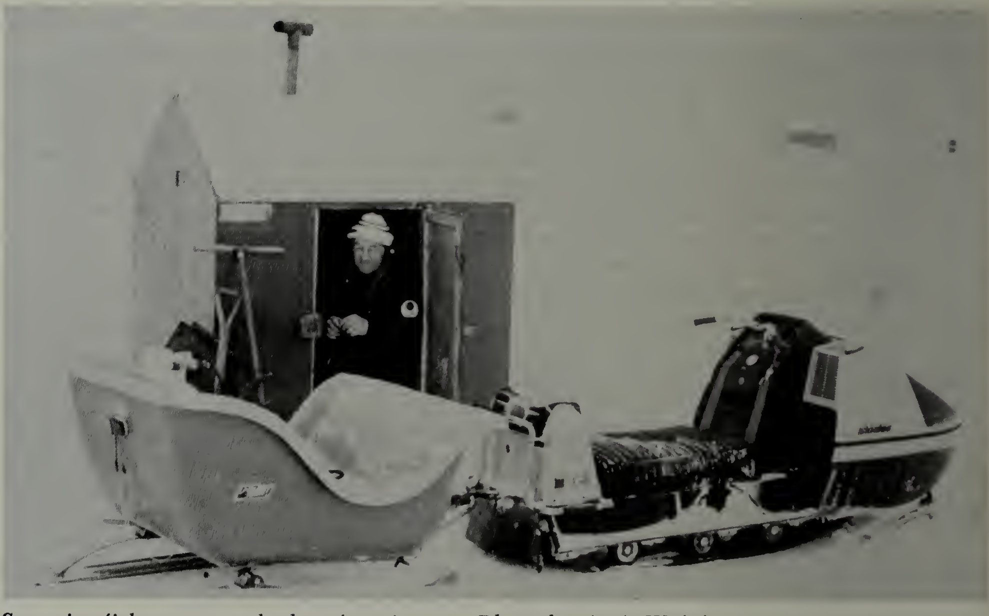
In 1974 an estimated 68,000 people invaded Lake Simcoe ice by snowshoe, snowmobile, wheeled vehicles and airplanes. They fished some 400,000 hours and harvested about 314,000 fish.

Anyone can try it. People from all walks of life, from professional hockey players to nuns, are to be found plying their angling skills and enjoying the challenge of trying to land a fish from beneath the ice. There are those who will never return but there are others for whom it will become a way of life.

By the middle of the 19th century, the Lake Simcoe fishery extended over four seasons of the year. Today 15 per cent of provincial anglers fish at least once a year in the lake. In winter, 37 commercial hut operators are ready to outfit the unprepared angler at a nominal fee. Fish huts are located at prime lake trout and whitefish grounds. For those wanting more rapid action, there are shanties positioned over yellow perch and herring haunts.

Ice fishing without a hut is gaining momentum each year. During the winter of

Ice fishing attracts people from all walks of life. Photo by A. A. Wainio.



Some ice fishermen need a lot of equipment. Photo by A. A. Wainio.

1975, these robust anglers represented 33 per cent of the fishermen on Lake Simcoe ice.

Being on a 280-square-mile chunk of ice can be an awesome experience. One might ask "How could man possibly influence so large an inland lake?"

The ecological stress flags are showing already and man appears to have triggered each and every one. It appears that artificial stocking has permitted lake trout catches to remain at a consistent level, but whitefish catches have declined drastically over the past five years.

A giant body of inland water such as this may appear strong and tolerant but it is ecologically sensitive. For Lake Simcoe to remain a viable natural resource, man will need to develop a keener sense af awareness.

Photo by Ted Jenkins

FISHING FOR FLAVOUR — SMELT

by M. R. Wolfe, Fish and Wildlife Supervisor, North Bay District

Smelt is thought to take its name from the words "smell it". The fish has a peculiar odor which is not unlike that of fresh cucumbers.

The rainbow smelt of Ontario, *Osmerus mordax,* is a slender, silvery fish, pale green on the back and with purple, blue and pink irridescence on the sides.

Shortly after the ice breaks up in the spring, the smelt leave the deep waters of lakes and begin to ascend streams to spawn. Spawning may last for as long as three weeks but usually the peak is less than a week. It is at this time that smelt are most vulnerable to fishermen.

In the Great Lakes the annual spring run of smelt is greeted by a horde of smelt fishermen using equipment ranging from bare hands to 30-foot seines. Dip nets made of fine mesh are most common. Other equipment includes waders and a large container for the catch and possibly wood and a fry pan for cooking smelt fresh from the water. In Ontario dip-nets may not be larger than six feet square and seine nets cannot be longer than 30 feet.

In winter smelt are taken by angling through the ice in some inland lakes. Usually a group of fishermen fish together and set their lines at different depths. When they locate the depth at which the smelt are feeding, they all set their lines at that depth. The bait is usually a small minnow placed on the hooks of a very small spoon. Smelt bite lightly so the line must be supported by a sensitive wire or tip-up such as that used for whitefish.

In many waters, the best bait is a strip cut from the smelt itself, near the tail. Other baits are bits of smelt skin, perch skin and brightly colored fins.

In the past 50 years, smelt populations have expanded rapidly in Ontario waters to the detriment of some native species. Much

of this expansion has been the result of inadvertent introductions by man. To prevent more introductions, legislation now prohibits the use of live smelt for bait. Spring fishermen should be aware that the eggs and milt of freshly caught smelt may remain viable for some time and they should avoid cleaning smelt where eggs and milt may get into natural waters.

Smelt are renowned as food fish and are in high demand. The best method of cleaning them is simply heading and gutting them. Sharp scissors are useful. Smelt are best when fresh, and delicious baked or fried. Kippered smelts are also tasty.

THE SMELT COOKERY

Sweet and Sour Smelt

This recipe is suitable for any species of fish. Smelts or herrings can be cut into bite-sized pieces and panfish can be filleted.

1 pound smelts
¼ cup vegetable oil
½ chopped onion
1 medium green pepper cut in thin strips
¼ cup brown sugar
1 tbsp. corn starch
½ tsp. dry hot mustard
1 tbsp. soya sauce
⅓ cup lemon juice
2 tbsp. water
Salt and pepper to taste.

Brush the fish with 2 tbsp. of oil and sprinkle with salt. Broil in oven about 15 minutes until fork-tender. Arrange on a platter and keep warm. Brown the onions in another 2 tbsp. of oil and stir in the pepper slices. Mix remaining ingredients and add to the vegetables in the skillet. Cook until sauce is thickened, stirring constantly. Spoon over broiled fish and serve immediately with a side dish of steamed rice. Serves four.

Smelt Provençale

Here is a simple French method of cooking smelt or panfish. It is different and piquant.

About 20 smelt dressed, left whole
1 tsp. salt
½ tsp. pepper
juice of one lemon
½ cup flour
3 tbsp. butter
1 tbsp. olive oil
2 tbsp. butter
3 shallots, chopped
2 garlic cloves, minced
3 tomatoes, skinned, chopped, drained.

Salt and pepper the fish, sprinkle well with lemon juice and roll them in the flour. Heat the three tablespoons of butter and olive oil in a skillet and brown fish evenly on both sides over medium heat. Takes about 15 minutes. Place fish on warm serving platter. In another skillet, melt the two tablespoons of butter and sauté shallots and garlic until soft. Add tomatoes and cook ten minutes, stirring often. Spoon this mixture evenly over the fish. Serves four.

AN UNKINDNESS OF RAVENS

Most of the 'nouns of abundance', 'nouns of assemblage' or 'terms of venery' (the medieval word for hunting) were codified during the 15th century when the English lanuage was in a process of expansion. The following official list was published in 1450.

Brood of hens
Covey of quail, grouse
Murder of crows
Pod of seals.
Rafter of turkeys
Nest of rabbits
Gang of elk
Fall of woodcock
Seige of herons
Shoal of bass
Drift of hogs
Trip of goats
Cast of hawks
Drove of cattle
Bouquet of pheasants
Congregation of plovers
Knot of toads
Descent of woodpeckers
Clutch of eggs
Dray of squirrels
Murmuration of starlings
Spring of teal
Swarm of bees
String of horses
Colony of ants
Kindle of kittens
Sloth of bear
Walk of snipe
Gam of whales
Dule of doves
Skulk of foxes
Business of ferrets
Bevy of deer
Charm of finches
Skein of geese (in flight)
Gaggle of geese (on water)
Cete of badgers
Unkindness of ravens
Richness of martens
Host of sparrows
Army of caterpillars
Flight of swallows
Clowder of cats
Route of wolves

— *R. M· Alison, Waterfowl Biologist, Wildlife Branch*

Rain erodes unstabilized slopes, washing sediment into stream.

HIGHWAY IMPACTS — THE GALT CREEK STUDY

Report and Photos by John S. Mathers
Biologist, Sport Fisheries Branch

GALT Creek, a small trout stream near Guelph, is the target of an important study being conducted by the Ministries of Natural Resources and of Transportation and Communications to determine the impact of highway construction, traffic and maintenance on a stream ecosystem.

Many studies have been conducted on the effects of various environmental impacts on streams, but we have seldom had the opportunity to study a stream before, during and after highway construction. We expect to be able to assess the total impact from many sources on the stream.

The University of Guelph had conducted earlier studies in the area, and 'Transportation and Communications' recognized that the construction of Highway 6N presented an excellent opportunity to obtain badly needed information. Because 'Natural Resources' has the expertise to carry out major biological investigations, it was asked to embark on a joint assessment of impact with T & C. The suggestion was accepted enthusiastically and the project began.

An increasing number of streams are being altered both physically and chemically by highways. Highway construction may cause physical environmental damage, and highway traffic and maintenance may cause chemical contamination.

One major impact during road building is an increase in the amount of sediment entering a stream. It may be generated by erosion at the construction site or by equipment crossing and working in streams.

In suspension, the sediment can kill fish by damaging the gills and can also cause behavioural changes in stream biota. In high concentrations, it can trigger invertebrate drift which, over extended periods of time, may reduce invertebrate populations. This in turn affects the fish species which depend on invertebrates for food. Fish migrations may be affected by suspended sediment as many species will avoid areas of high turbidity.

Another impact of suspended sediment may be a change in the primary production of a stream. It may decrease if sufficient

PARAMETERS MONITORED BY GALT CREEK STUDY

PHYSICAL	CHEMICAL	BIOLOGICAL
(a) SEDIMENT	(a) WATER QUALITY	(a) INVERTEBRATES
Turbidity Suspended, sediment concentrations Particle size composition of suspended sediment (1) Rates of sediment deposition Particle size composition of streambed material (2) (3) Organic composition of bed material (3) and deposited sediment Visual and photographic observations of sediment deposition and sources	pH Dissolved oxygen Alkalinity Specific conductance Sodium (4) Chloride (4) Calcium (4) Magnesium (4) Potassium (4) Total Kjeldahl nitrogen (4) Nitrate nitrogen (4) Total phosphorus (4) Soluble phosphorus (4)	Species composition and abundance of aquatic invertebrate benthic and artificial substrate samples. (b) FISH Seasonal species — composition and abundance Spawning site identification Spawning migration studies Metal concentrations in fish flesh (5)
(b) WATER Temperature Disharge Groundwater levels	(b) POTENTIAL CONTAMINANTS Phenols (4) Ether extractables (4) Petroleum hydrocarbons (4) Cadmium (5) Chromium (5) Cobalt (5) Copper (5) Iron (5) Manganese Mercury (5) Nickel (5) Lead (5) Zinc (5)	

ANALYSES PERFORMED BY —

(1) Brock University
(2) Water Survey of Canada
(3) Ministry of Tranportaion and Communications
(4) Ministry of the Environment
(5) Ministry of Agriculture & Food

amounts of solar radiation are screened out by the sediment, or it may increase if the sediment provides additional nutrients.

Further impacts result when the sediment settles on the stream bed. Sediment fills gravel interstices, destroying the habitat of many invertebrate species which are important fish food. It can also smother incubating fish eggs and destroy spawning beds.

When bank vegetation is removed during highway construction, an increase in the amount of sunlight reaching the stream can raise the water temperature. This may make the stream unsuitable for certain fish and invertebrate species which require cool water.

Stream channelization reduces the area available for fish production by straightening stream meanders. Moreover, stream topography is altered, causing a loss of riffles, pools and under-cut banks which provide fish habitat.

The water supply of streams can be affected in several ways by highway construction. The removal of topsoil and vegetation can dry up swamps which normally serve as reservoirs. Drainage ditches and highway paving accelerate run-off, thus reducing the amount of ground water stored. Increased run-off causes high peak flows which can damage banks downstream.

Once a new highway is in use, the water quality may be impaired by contaminated run-off. De-icing chemicals are a major source of pollution, and the sand used with salt may be washed into the stream. Other contaminants may be found in debris washed from the highway. These include lead and nickel exhaust emissions and the zinc and cadmium present in motor oil and tires. In addition, any subtance transported on the highway is a potential contaminant in the event of an accident.

Another group of potential contaminants are the herbicides used in right-of-way main-

During ditch excavation, an earthen plug prevents sediment-laden water from entering the creek.

A sedimentation pond traps sediment before it enters the creek.

Checking stream temperature with maximum-minimum thermometer.

Sampling stream invertebrates with a Surber sampler.

tenance. Many of these chemicals are toxic to aquatic biota in low concentrations.

The Galt Creek study is monitoring the physical, chemical and biological parameters (see table) of the Galt Creek ecosystem during three phases — pre-construction, construction, and post-construction. One year before construction began, we collected background data on this system. During construction, we monitored the impacts of the sedimentation. The monitoring program is now in its final year, studying the problems of post-construction contamination.

A notable feature of this study is that before construction began, biologists and engineers co-operated in developing plans to reduce the amount of sediment entering the stream. An important control was the construction of sedimentation ponds through which drainage from the construction site was channelled.

Other measures included timing of construction to minimize the amount of disruption to the stream; plugs at the downstream end of ditches to hold back sediment-laden water during excavation; sand-bag stream checks to trap sediment; and temporary seeding and chemical soil stabilization of steep slopes to reduce erosion. Monitoring the effectiveness of these measures is an integral part of the study.

Another feature of the program is that stream rehabilitation will be conducted once highway construction is complete. This should improve Galt Creek and it may develop techniques which can be used to rehabilitate other damaged streams.

We are confident that this study will provide information useful to both biologists and engineers concerned with highway impacts on the natural environment. In addition, we hope that the successful co-operation achieved by biologists and engineers on this project will stimulate further co-operation. Finally, we anticipate that the findings of this study will result in improved highway design and construction practices so that impacts on stream ecosystems will be minimized.

Fish habitat is lost by the ditching of streams.

Heavy equipment greatly increases the sediment suspended in water.